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Implementation of the proposals for action of the Intergovernmental Panel on Forests/Intergovernmental Forum on Forests and the plan of action of the United Nations Forum on Forests

Progress in implementation: forest health and productivity

Report of the Secretary-General

Summary

Forest health and productivity are negatively affected by a variety of factors, including air pollution, wildfires, pests and diseases and storm damage. Air pollution was an issue of high visibility and concern at the time of the deliberations of the Intergovernmental Panel on Forests (IPF, 1995-1997). IPF agreed upon several related proposals for action, calling for countries to adopt preventive measures to reduce air pollution and for the international community to develop or continue to implement national and international programmes for monitoring air pollution and its effects on forests, and to conduct in-depth studies on causes of forest degradation and deforestation. The Intergovernmental Forum on Forests (IFF, 1997-2000) did not adopt any new proposals related to forest health and productivity. The present report presents an overview of action taken regionally and nationally in response to the IPF proposals for action.

The relevant IPF proposals for action have largely been implemented in Europe, where the problem has been most salient. In view of the increasing threat to forests posed by air pollution in many regions of the world, the report stresses the need for countries to monitor the effects of air pollution and other natural and anthropogenic threats to forest health. The adoption of harmonized methods and reporting formats used in ongoing international monitoring programmes will enhance countries' possibilities to cooperate in the development and implementation of efficient and cost-effective air pollution abatement strategies.

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Although IPF/IFF concentrated on air pollution impacts, forest health and productivity are affected by other major threats, including insects and diseases (biotic factors), wildfires, storms, snow/ice and oil spills (abiotic factors) and people (social factors). The report considers those threats as emerging issues and proposes action to prevent and respond to such threats, in particular forest fires and pest and disease outbreaks.

The report stresses preventive approaches, regional collaboration, networking and systematically collecting, analysing and disseminating information as critical strategies for effectively dealing with emerging threats to forest health and productivity and reducing reliance on ad hoc responses to such disasters.

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I. Introduction

1. The present report reviews and analyses efforts by countries, regions and international organizations to implement the proposals for action related to forest health and productivity agreed upon by the Intergovernmental Panel on Forests (IPF).[1] Although the proposals for action focus on transboundary air pollution, a topical issue at the time of IPF, there are currently many other threats to forest health and productivity of concern, including wildfires, forest pests and diseases, and storm damage.

2. The report was prepared by the Food and Agriculture Organization of the United Nations (FAO), with significant contributions from the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests, operating under the auspices of the Economic Commission for Europe (ECE).[2] Sources of information used to prepare the report included national reports to the United Nations Forum on Forests at its third session that were available at the time of preparation; national reports to the Commission on Sustainable Development; reports of relevant country-led initiatives in support of IPF, the Intergovernmental Forum on Forests (IFF) and the United Nations Forum on Forests; information and inputs from members of the Collaborative Partnership on Forests;[3] scientific and policy-related literature; and Internet searches. The network of collaborators of the International Cooperative Programme also contributed to the report.

II. Background

3. IPF noted that airborne pollution was negatively affecting forest health in many parts of the world. It encouraged countries to adopt preventive approaches and to strengthen international cooperation to address the problem. IPF requested countries and the international community to:

(a) Adopt a preventative approach to reduce air pollution (see E/CN.17/1997/12, para. 50 (a));

(b) Strengthen international cooperation to access scientific knowledge and information and reduce long-range air pollution (see E/CN.17/1997/12, paras. 50 (b) and (e));

(c) Develop national and regional programmes for monitoring air pollution and provide information about transboundary pollution (see E/CN.17/1997/12, paras. 27 (c), 50 (c) and 50 (d)).

4. In reviewing action taken, IFF took note of ongoing monitoring of the effects of air pollutants on forests in Europe and North America, the establishment of new protocols under the ECE Convention on Long-Range Transboundary Air Pollution, and regional cooperation in monitoring air pollution and its effects on forests in South and South-East Asia. However, IFF did not formulate any new proposals for action related to forest health and productivity.

5. In its resolution 2000/35, the Economic and Social Council called upon the United Nations Forum on Forests to facilitate the implementation and monitoring of progress of the IPF/IFF proposals for action, as well as to address emerging issues. The present report thus addresses concerns related to the health and productivity of

forests beyond the effects of air pollution, including pests and diseases, forest fires and storm damage.

6. Numerous studies reveal that profound changes in forest ecosystem processes are caused by air pollution. Sulphur and nitrogen inputs persisting for many decades have not only impaired the health of trees but have also caused severe, long-term damage to forest soils and ground vegetation. As a result, many forest soils are acidic, their filtering function is impaired and they increasingly release pollutants into groundwater.

7. Systematic monitoring carried out mostly in Europe by the International Cooperative Programme reveals decreasing sulphur deposition in forest soils. In some highly damaged forest areas of central Europe, recent recuperation of crown condition of trees has partly been attributed to the improvement of air quality. However, nitrogen deposition in forests has hardly decreased at all. In developing regions, forests are also suffering from the effects of long-range air pollution (e.g., in Mexico and India[4] and China). For example, recent evidence suggests that aerosol pollution may suppress local rainfall, an effect that is particularly damaging to forest health in tropical latitudes.[5]

8. Concentrations of atmospheric carbon dioxide have also risen since the pre-industrial era. Ozone concentrations in many areas of Europe and North America are sufficient to adversely affect tree growth, cause foliar injury and early needle loss, and increase susceptibility to bark beetles.

9. Global models predict that, until 2050, risks to forest ecosystems from acidification will remain fairly constant in Europe and North America but will increase significantly in East Asia and in some parts of the east coast of South America, mainly due to increased sulphur emissions in those regions.[6,7]

III. Implementation of the IPF/IFF proposals for action

A. Progress in implementation

1. Global overview of air pollution abatement policies and implementation

10. In the late 1970s and early 1980s, increasing forest damage, mainly in parts of central Europe, was attributed to local and long-range transboundary air pollution,[8,9] and the wide occurrence of those new types of forest damage across Europe became obvious.[10] More than two decades of forest damage research and 16 years of monitoring forest conditions in Europe[11] have concluded that the symptoms observed can be attributed to a range of natural and anthropogenic factors, air pollution being a significant one.

11. Evidence of forest damage due to air pollution in Europe, North America, parts of the Russian Federation and other regions of the world has led to various commitments and to the implementation of air pollution abatement policies at the national and international levels. An overview of those responses is set out below.

2. Europe

Ministerial Conference on the Protection of Forests in Europe

12. The deterioration of the quality of European forests in the 1980s due to damage by air pollution led to cooperation among countries for the protection and sustainable management of forests in Europe. The first Ministerial Conference on the Protection of Forests in Europe was held in Strasbourg, France, in 1990. That political process was considerably strengthened by the second Conference (Helsinki, 1993), which enhanced the commitment to implement the forest-related United Nations Conference on Environment and Development (UNCED) decisions and sustainable forest management in Europe, and by the third Conference (Lisbon, 1998), which highlighted the socio-economic implications of forests. The fourth Conference, the "Living Forest Summit", was held from 28 to 30 April 2003 in Vienna.

Convention on Long-range Transboundary Air Pollution[12]

13. The ECE Convention on Long-range Transboundary Air Pollution entered into force in 1983. It currently has 49 parties, mainly European countries, Canada and the United States of America. The Convention provides an institutional framework for linking science and policy. Scientific information, which constitutes the basis for the development of air pollution abatement strategies, is provided by the Working Group on Effects and its international cooperative programmes, the largest of which is the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests,[13] which, in close cooperation with the European Commission, operates one of the world's largest bio-monitoring networks (see para. 39 below). The Convention encompasses eight protocols, which constitute the basis for national air pollution abatement policies. Five of the protocols are in force, on the further reduction of sulphur emissions; the control of emissions of volatile organic compounds; the control of nitrogen oxides; the reduction of sulphur emission or their transboundary fluxes by at least 30 per cent; and long-term financing for monitoring. Three protocols are not yet in force, on abating acidification, eutrophication and ground-level ozone; persistent organic pollutants; and heavy metals.

14. Air pollution abatement policies in countries participating in the work of the Convention have led to a clear decrease in emissions in Europe, especially of sulphur compounds.

Clean air policies of the European Union

15. The European Union (EU)[14] is party to the Convention and ratifies its protocols through corresponding EU directives. Complementary and additional legislation is also being developed, including the determination of national emission ceilings in EU countries for sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds and ammonia.[15] The 1986 regulation on the protection of forests against air pollution provides the legal basis for forest-monitoring activities in EU countries. The regulation expired at the end of 2002, but a follow-up process has been launched.

16. The Clean Air for Europe programme aims to develop, collect and validate scientific information on the effects of air pollution and to ensure that the requisite measures are taken at the most appropriate level.

17. In addition, a number of other measures that aim to control air pollution and reduce emissions have been taken, including in the transport and energy sectors.

3. North America

18. Canada and the United States of America, in addition to being parties to the Convention, have together signed the following international commitments with one another and/or with Mexico related to air quality and acid deposition:

(a) The *Canada-United States Air Quality Agreement (1991)* aims to reduce acid rain by cutting emissions of SO_2 and NO_x. Under the agreement, an international joint commission coordinates the public review of the two countries' progress reports in implementing the agreement;

(b) The *North American Agreement on Environmental Cooperation*, which operates under the aegis of the North American Free Trade Agreement, has been signed by Canada, Mexico and the United States and came into force in 1994. It sets out a framework for environmental regional cooperation, including regarding air pollution;

(c) The *Agreement between the United States of America and Mexico on Cooperation for the Protection and Improvement of the Environment in the Border Area*, the "La Paz Agreement", was signed in 1983 and is implemented through multi-year programmes. Cross-border working groups focus on specific environmental issues, including air quality.

19. Air pollution problems within the Southern Cone Common Market (MERCOSUR) region have been tackled by leaders of civil society in Argentina, Brazil, Paraguay and Uruguay in a policy dialogue that started in 1998 with the signature of the *Cañuelas Declaration on the Control and Prevention of Atmospheric Pollution in Mercosur Countries*.[16] The process was funded by the Swedish Development Cooperation but is no longer active.

20. The Canadian Forest Service and the United States Department of Agriculture Forest Service collaborate with the International Cooperative Programme through joint workshops and projects; there are also a number of research cooperation agreements in the field of air pollution effects on forests between latter Forest Service and some European countries with economies in transition.[17]

4. Asia

21. Air pollution in many countries in Asia has been increasing in the wake of growing industrial activities, rising vehicle densities and repeated fires, resulting in several international agreements to monitor air pollution and its effects and, the preparation of air pollution abatement policies in a number of countries in the region.

22. In East Asia, collaborative research projects on air pollution and its effects are conducted by the Republic of Korea, Japan and China, which have started trilateral research activities on long-range transboundary air pollution based on emission inventories and modelling.

23. The Governments of the member countries of the Association of Southeast Asian Nations (ASEAN; members are Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam) signed the *ASEAN Agreement on Transboundary Haze Pollution* in June 2002.[18] It is the first regional agreement in the world in which a group of contiguous countries have together addressed transboundary haze pollution resulting from land and forest fires.

24. The *Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia*,[19,20] was adopted in 1998. Participating countries are Bangladesh, Bhutan, India, the Islamic Republic of Iran, Maldives, Nepal, Pakistan and Sri Lanka. Implementation of the regional agreement is coordinated by the South Asia Cooperative Environment Programme and the United Nations Environment Programme (UNEP), in collaboration with national Governments. The first phase of implementation consisted of an evaluation of the status of knowledge and research related to air pollution. The second phase envisages the development of a monitoring network, as well as studies on integrated assessment modelling and emission inventory methodologies. The third phase aims to further develop related national policy processes. Collaboration with related processes in Asia, such as the Acid Deposition Monitoring Network in East Asia and the Integrated Monitoring Programme on the Acidification of Chinese Terrestrial Systems, is anticipated.

5. Africa

25. In 1998, a number of countries in Southern Africa signed the *Harare Resolution on the Prevention and Control of Regional Air Pollution in Southern Africa and its Likely Transboundary Effects*.[21] The corresponding policy process was established within the framework of the Southern African Development Community (SADC). Activities receive funding from the Swedish Development Cooperation through the Air Pollution Information Network in Africa. Work is coordinated by the Universities of Zambia and Zimbabwe.

26. The *Cross-border Air Pollution Impact Assessment* project addresses the impacts of tropospheric ozone on agriculture in South Africa. The *Southern African Regional Science Initiative* is a network for studying the interactions of anthropological, biological and climatological phenomena in southern Africa. The initiative is co-financed by Governments of the region and the United States through its National Aeronautics and Space Administration.

27. There is close collaboration between all of the above-mentioned initiatives in southern Africa.

6. Implementation at the national level

28. A complete overview of progress in the implementation of the IPF/IFF proposals for action related to forest health and productivity is dependent on up-to-date, country-based information. To date, 22 voluntary country reports have been submitted to the Forum for its third session. To obtain a more complete picture of national activities, the sections related to forests of 121 national reports to the Commission on Sustainable Development[22] were screened.

29. Air pollution problems and related international obligations and responses through national legislation and policies were mentioned more frequently by countries in Europe, while air pollution was less frequently mentioned in the reports of countries in South America, Asia and Africa, which may be indicative of the relative level of attention paid to air pollution in different regions of the world.

30. The implementation of air pollution abatement policies has led to a remarkable improvement of air quality in countries in Europe and North America: sulphur emissions have been reduced by about one third in Europe and by about one half in North America over the past decade.

B. Means of implementation

31. Programmes addressing air pollution in Europe and North America were initiated prior to UNCED. The discussions in IPF and IFF helped strengthen action under way and, by further raising the political profile of the work, helped enhance funding possibilities and the sustainability of related activities. The international forest policy debate also helped to raise political awareness in other regions of the world, underpinning agreements on common air pollution and haze abatement in Asia and providing additional justification for requests for assistance and financial support to confront related problems in southern and central Africa.

32. The success achievable through networking between countries, which is founded on existing capacity and know-how and enhanced by exchange of information and experience, has been amply demonstrated by the positive effects that programmes, especially in Europe, have had on levels of pollution and forest health. Experience has demonstrated the need to make the fullest possible use of existing regional and political groupings, which can provide powerful frameworks for sustained action. Intersectoral collaboration within countries has been recognized as a fundamentally important principle and prerequisite for success, since the forest sector alone cannot provide all the necessary solutions.

33. North/North collaboration has been significant, and some South/South cooperation is under way among ASEAN and to some extent SADC countries. More such efforts are needed, however, to make the best use of scarce resources, help avoid overlap and duplication, and enhance possibilities for capacity-building and exchange of know-how and technologies. An example of North-South cooperation is the United States Environmental Protection Agency air and climate programmes in Latin America and the Caribbean.

C. Monitoring, assessment and reporting

34. Until recently, the problem of acid deposition was most prevalent in Europe and North America. Related monitoring and research efforts have been comparatively well developed in countries in those two regions. Some information has also been collected by some countries in Asia.

35. Regional monitoring networks have been established in Europe, North America and East Asia (see paras. 38-45 below). It should be noted that, with the exception of the International Cooperative Programme, they are not solely focused on forests.

36. Little is known, however, about the extent and impact of air pollution in most other regions. Current concerns about air pollution in developing countries have focused on its negative influences on the health of urban populations in large cities, such as Mexico City.[23]

37. "Forest health and vitality" and "productive functions of forests" are included in the criteria for sustainable forest management developed in the regional and international processes on criteria and indicators for sustainable forest management. Several countries are monitoring many aspects of forest health and productivity, including aspects beyond air pollution (see paras. 46-66 below).

1. Europe[24]

38. In Europe, monitoring of air pollution is carried out systematically and extensively; results are regularly published in the annual ECE publication *Forest Condition in Europe*.

39. Thirty-nine countries, mostly European ones, take part in the joint forest monitoring activities of the International Cooperative Programme and the EU. Established in 1985, the network is today one of the world's largest bio-monitoring programmes for monitoring the effects of natural and anthropogenic stress factors (in particular air pollution) on forests. It is based on harmonized methods and on strict quality assurance procedures established in a manual published in three official United Nations languages (English, Russian and Chinese).

40. Some countries have indicated in their national report to the Forum at its third session the need for further investment in the development of better methods and more intensive monitoring.

2. North America

41. In Canada, modelled deposition maps of sulphur and nitrogen are provided by the Atmospheric Environment Service, which is operating under Environment Canada. The Forest Health and Biodiversity Network of the Canadian Forest Service conducts research on air pollution effects on forests based on those maps.

42. The Forest Service of the United States Department of Agriculture relies on data from the Clean Air Status and Trends Network[25] for dry acid deposition measurements. The Network is operated by the Environmental Protection Agency and the National Park Service. The Service also participates in the National Atmospheric Deposition Program,[26] which operates more than 200 sites for the collection of information on wet acid deposition.

3. Asia

43. The Acid Deposition Monitoring Network in East Asia[27] initiated activities in 1998. Currently, 12 countries are participating in the Network: Cambodia, China, Indonesia, Japan, Lao People's Democratic Republic, Malaysia, Mongolia, Philippines, Republic of Korea, Russian Federation, Thailand and Viet Nam. The network collaborates with the International Cooperative Programme. Joint activities include a workshop conducted in Malaysia in December 2002, focusing on monitoring methods.

44. A network of air pollution monitoring stations is planned under the Malé Declaration in South Asia.

45. The Integrated Monitoring Programme on the Acidification of Chinese Terrestrial Systems[28] has been operational since the year 2000, but the continuation of the programme is uncertain due to a lack of funds. Five monitoring sites have been established in Chinese forests, following the standards of the International Cooperative Programme.

D. Forest health in a broader context: emerging issues

46. Factors that affect forest health but are not specifically addressed by IPF/IFF proposals for action are also important sustainable forest management. Biotic factors, such as insects and diseases, and abiotic factors, such as forest fires, are increasingly causing damage to forests and are linked with atmospheric pollution. Less well documented are the impacts of oil pollution, caused by spills from oil tankers or from near or offshore oil-boring facilities, which can have significant adverse impacts on mangrove forests. It is recommended that the Forum give due consideration to those factors as emerging issues.

47. Indicators defining health and vitality aspects under the regional and international processes on criteria and indicators for sustainable forest management address many of the factors mentioned above. For example, defoliation is one of the indicators of forest health and vitality monitored in many boreal and temperate regions. It is dependent on many stress factors and is therefore a valuable measure to describe overall forest condition. Defoliation evaluations are carried out mainly in Europe, United States and Canada, and to some exte nt in East Asia. An indicator of forest health that is often suitable in tropical regions is the amount of post-logging woody debris after timber extraction, as excessive amounts of woody debris leave forests in a highly fire-prone state by lowering the forest's buffering capacity against fires[29] and also provide insect breeding sites.

48. The initiative on assessing overall forest condition in Indonesia, being carried out by the South Asian Regional Centre for Tropical Biology, the International Tropical Timber Organization (ITTO) and the United States Department of Agriculture Forest Service, is monitoring forest health using indicators. The initiative aims to implement a forest health monitoring method originally devised for temperate forests.[30]

1. Forest fire

49. Globally, an estimated 300 to 400 million hectares (ha) of forests and woodlands burn annually.[31] Major fire events of the previous two decades, such as those in 1982-1983 and 1997-1998, can be correlated to El Niño episodes. Millions of hectares burned in 1997 and 1998 and smoke blanketed large regions of the Amazon Basin, Central America, Mexico and South-East Asia.[32] It was estimated that carbon emissions from burning peat and vegetation in Indonesia in 1997 were equivalent to 13-40 per cent of the mean annual global carbon emissions from fossil fuels.[33]

50. Fire has always strongly influenced plant communities and serves an important function in maintaining the health of certain ecosystems. Fire is frequently used as a land-clearing tool in developing countries. However, wildfires or fire escapes

frequently destroy forest vegetation and biomass, resulting in considerable soil erosion by wind and water. Damage also negatively affects landscapes and livelihoods, haze pollution and deposition of pollutants.

51. The emphasis in many places is on emergency response, which will not prevent large and damaging fires in the future. More emphasis should be placed on the development of proactive fire management models that take into consideration human-induced causes of fire. A major conclusion of the Food and Agriculture Organization of the United Nations (FAO) meeting on public policies affecting forest fires, which was held in Rome in 1998, was that fire management programmes must be coupled with better land-use policies and practices. Meetings were held on community-based fire management in Bangkok in 2000 and to address the causes of fire and the engagement of rural people in preventing and suppressing forest fires in Balikpapan, Indonesia, in 2001.

52. An example of dramatic reductions in the area affected by forest fires can be found in Namibia,[34] which since 1996 has pioneered strategies for the widespread involvement of local and traditional authorities and communities in the management of forest fires. Namibia developed national guidelines for forest fire management; the first such guidelines in Africa. Those guidelines combined all fire, forest and emergency response legislation under one umbrella managed by a task force, headed by the Director of Forestry. Namibia also developed capacities to carry out fire-scar mapping and to monitor the effectiveness of fuel breaks and cross-border fires with the neighbouring countries of Angola, Zambia and Botswana. Collaboration on community-based fire management techniques between Namibia and Mozambique resulted in a significant reduction in wildfires in 2002.

53. Many countries are developing similar types of policies and practices, including regional collaboration, such as the development of transboundary agreements to address forest fire emergencies (e.g., those in the ASEAN and Mediterranean regions in 2002). There is also active collaboration on fire management practices by members of the Collaborative Partnership on Forests and other international organizations and bodies, including FAO, the Global Fire Monitoring Centre,[35] UNEP, ITTO, the Center for International Forestry Research, the World Conservation Union (IUCN) and the World Wide Fund for Nature.

54. Some countries and regions have well developed systems for collecting, reporting and evaluating wildfire statistics, but frequently these are insufficient to estimate the nature or impact of the fire. Many countries do not report the occurrence of fires and area burned each year. Satellite imagery, in combination with ground truth verification, has been used to map active fires and burned areas, especially in remote areas. Such institutions as the Global Fire Monitoring Centre, which operate in collaboration with FAO and ECE, have been instrumental in bringing the world's fire situation to the attention of a global audience via the Internet. The Forest Service of the United States Department of Agriculture is leading a national effort to develop cooperative centres for high-resolution meteorology modelling in order to provide regional simulations of weather and weather-dependent phenomena, including fire danger, fire behaviour and smoke distribution.[36]

55. After the Chernobyl power plant accident in 1986, forests in the area accumulated radionuclides to a much greater extent than any other natural landscape.[37] Forests in the most contaminated regions of the Ukraine, Belarus and

the Russian Federation consist mainly of immature and middle-aged pine and pine-hardwood stands, in high fire-danger classes. In 1992, wildfires spread into the 30-kilometre buffer zone around the power plant and the level of radioactive caesium in aerosols increased 10 times due to those fires.[38] Another 800 ha of forest and peatlands in the contaminated areas in Belarus burned in July 2002.[39] The risks of a renewed suspension of radioactive matter from still bigger forest fires in the contaminated areas are currently difficult to estimate.

2. Abiotic factors, including storm damage and impact of climate change

56. Abiotic factors, such as wind, snow, ice and floods, have always influenced forest ecosystems. In Europe, a comprehensive overview of forest damage events is provided by the Database on Forest Disturbances in Europe of the European Forest Institute.[40] In 2001, abiotic agents were registered on 10 per cent of the assessed EU/International Cooperative Programme plots (level I).[41] In general, information on damage by abiotic factors is highly erratic. However, the number of catastrophic climate events that has occurred over the past decade seems to go well beyond what could be considered normal meteorological oscillations.

57. The effect on European forests of the hurricanes of December 1999 and the floods of 2002 are well documented. In France, Switzerland and southern Germany, the storms of 1999 felled approximately three times the normal annual cut of trees and timber.[42] In response, some countries have made efforts to modify silvicultural practices to minimize the risk of damage by storms.

58. In October 1998, hurricane Mitch struck Honduras and Nicaragua. Hurricane Mitch has been called the deadliest Atlantic hurricane since 1780[43] and was accompanied by excessive rainfall resulting in flash floods and mudslides that killed thousands of people. Entire landscapes were destroyed and large areas negatively affected.[44]

59. It is widely recognized that global climate change, compounded by human activities, is making forest ecosystems more prone to damage by altering the frequency, intensity, and timing of fire events, hurricanes and ice storms, and insect outbreaks.[45] Reported climate-related shifts in the range of species,[46] many of which are forest-dependent, can further exacerbate abiotic impacts on forest health.

60. The Intergovernmental Panel on Climate Change has concluded that the Earth's climate system has demonstrably changed on both the global and regional scales. Since quantification of such changes is not possible, responses through adjustments in forest management and silvicultural practices are limited. However, the creation of stable, well-adapted forest stands of mixed species composition and age classes, managed according to principles of sustainability, will also help to minimize potential damage due to adverse weather conditions.

3. Forest pests and diseases

61. Pests and diseases are natural components of forest dynamics and often fulfil important functions. However, under certain conditions they may have adverse effects on the growth and survival of trees, the yield and quality of wood and non-wood products and on the functions of forests, such as soil and water conservation. Pest outbreaks can cause considerable economic and environmental losses, may

compromise national economies, local livelihoods and food security, and may result in forest product trade restrictions.

62. The impact of forest diseases and insect pests has been profound over the centuries. The lack of effective quarantine measures, coupled with increased international trade in agricultural and forest products, the exchange of plant materials and long-range air travel have resulted in the introduction of pathogens and insects into new environments that has led, in some places, to significant forest damage.

63. Yet, despite the significant adverse impacts of forest pests and diseases and indications that outbreaks are on the increase, pests and diseases are often not considered in the planning of forest and forest conservation programmes. There has also been no attempt to systematically gather and analyse comprehensive information on the type, scale and impact of such outbreaks at the global level.

64. A recent initiative by FAO to develop a global forest information system aims to facilitate access to such information in order to improve the reliability of risk assessments and the design and application of cost-effective forest protection strategies.

65. The growing number of requests over the last decade from member countries to FAO for technical assistance related to forest health problems indicates an increasing threat to forests by biotic agents, including insects, pests and diseases. Some 300 outbreaks have been recorded in the FAO database to date, and between 1980 and 2002 more than 52 million ha of forests were reported to have been damaged by pests. With further analysis of that information, supplemented by information from past experience and additional data from countries, it may be possible to project and forecast potential future pest outbreaks.

66. Prevention of the spread of pests and diseases through international and national phytosanitary legislation and regulations is dealt with through the International Plant Protection Convention, a multilateral treaty for international cooperation in plant protection adopted in 1951; as of November 2002, 120 countries were parties to the Convention. The revised text of the Convention that was adopted in 1997 formalized its role as the global mechanism for phytosanitary standard-setting. More than 15 international standards for phytosanitary measures have been endorsed through that system and are now legally binding in countries that are parties to the Convention.

IV. Conclusions

67. Acidic deposition derived from sulphur and nitrogen pollution was until recently considered to be restricted to Europe and North America. However, ongoing industrialization and developing economies have increased emissions elsewhere. Air pollution and resulting damage to forests and the emission of pollutants into groundwater is predicted to rise dramatically in East Asia, along parts of the east coast of South America and around large urban agglomerations worldwide.

68. The effect of airborne pollutants on forest health is a typical example of a forest-related problem whose solutions clearly lie outside the forest sector. Acid rain, for example, has been greatly diminished by the adoption of cleaner industrial

production technology in eastern Europe and by the closing down of outdated industrial installations.

69. The IPF proposals for action that refer to the negative effects of air pollution on forests have largely been implemented in Europe. Research and monitoring back up the development and implementation of air pollution abatement policies. Similar efforts have been made in countries in North America. Some work has also been initiated in Asia and southern/central Africa.

70. The clean air policies implemented in a number of countries and regions are imperative and are among the core policies aimed at safeguarding natural resources in the long term. Measures for air pollution control, buffering against climatic events, energy policy and the adjustment of agricultural policies complement each other in that respect.

71. The results of monitoring carried out to date have had a considerable impact on public opinion in some countries, especially in Europe, as well as on the implementation of abatement policies, leading to a decrease in the emissions of airborne pollutants. Continuous monitoring of forest ecosystems is an expensive process that is difficult for developing countries and countries with economies in transition to carry out. Damage to forests by air pollution and other biotic and abiotic factors is rapidly increasing. Forests fires, pests and diseases pose increasing threats to forest health and productivity.

72. The following actions are recommended:

(a) Regional cooperation for monitoring should be encouraged and facilitated by international organizations;

(b) Intergovernmental efforts to gather, analyse and widely disseminate reliable and country-based information on forest health factors must be further strengthened in order to provide a solid basis for decision-making and enhanced field-level action which, to be successful, must ensure wide stakeholder involvement and continue to pay due attention to both preventive and remedial action;

(c) Experience has also demonstrated the need to make the fullest possible use of existing regional and political mechanisms, which can provide powerful frameworks for sustained action.

V. Points for discussion

73. The Forum may wish to:

(a) Urge countries to develop further preventive and remedial action to reduce air pollution and minimize the negative impacts on forests, engage in and enhance regional networking, and reduce reliance on ad hoc responses to environmental disasters;

(b) Urge countries to continue to strengthen clean air policies and work to ensure complementarity among such policies and energy and agricultural policies;

(c) Urge countries that have not yet done so to sign relevant agreements, such as the Convention on Long-Range Transboundary Air Pollution, and to cooperate regionally in the development and implementation of air pollution abatement strategies;

(d) Urge countries, as a basis for the development and implementation of clean air policies, to increase their efforts to monitor the effects of air pollution and other natural and anthropogenic causes of forest damage, using methods and reporting formats compatible with existing international monitoring programmes, such as those developed by the International Cooperative Programme in Europe and the Acid Deposition Monitoring Network in East Asia;

(e) Invite countries and regional and international criteria and indicators processes to include critical factors of forest health in the indicators of sustainable forest management and support the collection of information that is comparable among countries and processes, and may also wish to invite Partnership members and other international and regional organizations to facilitate regional collaboration in that regard;

(f) Call upon countries to develop bilateral and subregional agreements and proactive fire management models to enhance the capabilities of countries to manage forest fires;

(g) Encourage countries to implement activities in the expanded programme of work of the Convention on Biological Diversity on forest biological diversity related to forest health and forest fires;

(h) Invite Partnership members and other relevant organizations to support studies leading to increased understanding of the potential impacts on forest health of both short-term climatic events and long-term climate change, and to suggest practical actions for sustainable forest management to mitigate potential negative impacts.

Notes

[1] See http://www.un.org/esa/forests/documents-ipf.html.

[2] See http://www.icp-forests.org.

[3] See http://www.fao.org/forestry/cpf.

[4] See L. I. De Bauer et al., "Air pollution problems in the forested areas of Mexico and Central America", and M. Agrawal and S. B. Agrawal, "Research on air pollution impacts on Indian forests", in J. L. Innes and A. H. Haron, eds., *Air Pollution and the Forests of Developing and Rapidly Industrializing Countries* (United Kingdom, CABI Publishing, 2000).

[5] See Rosenfeld, "Suppression of rain and snow by urban and industrial air pollution", *Science*, vol. 287 (2000).

[6] See J. C. I. Kuylenstierna, H. Rodhe, S. Cinderby and K. Hicks, "Acidification in developing countries: ecosystem sensitivity and the critical load approach on a global scale", *Ambio*, vol. 30, No. 1; see also http://www2.york.ac.uk/inst/sei/rapidc2/monmod.html.

[7] See J. C. I. Kuylenstierna, W. K. Hicks, S. Cinderby, H. W. Vallaci and M. Engardt, "Variability in mapping acidification risk scenarios for terrestrial ecosystems in Asian countries", *Water Air and Soil Pollution*, vol. 130, Nos. 1-4.

[8] See P. Schütt, "Buchen- und Tannensterben: zwei altbekannte Waldkrankheiten von Höchster Aktualität", mitt. d. Deutschen Dendrolog Gesellschaft 71 (1979).

[9] See B. Ulrich, "Destabilisierung von Waldökosystemen durch Akkumulation von Luftverunreinigungen", *Der Forst- und Holzwirt*, vol. 36, No. 21.

[10] See F. Scholz and M. Lorenz, "Schadensursachen und Wirkungsmechanismen bei den Waldschäden", *Allgemeine Forst Zeitschrift*, vol. 39, No. 51/51.

[11] See http://www.icp-forests.org/RepTecI.htm.

[12] See http://www.unece.org/env/lrtap.

[13] See http://www.icp-forests.org.

[14] For an overview, see http://europa.eu.int/scadplus/leg/en/s15004.htm.

[15] See EU directive 2001/81/EC of 23 October 2001 on national emission ceilings.

[16] See http://www1.york.ac.uk/inst/sei/rapidc/policy/canu.html.

[17] See A. Bytnerowicz, D. Karnosky, W. Manning, M. McManus, R. Musselman and R.-M. Muzika, "Importance of international research cooperative programmes for better understanding of air pollution effects on forest ecosystems in central Europe", in R. Szaro, A. Bytnerowicz and J. Oszlányi, eds., *Effects of Air Pollution on Forest Health and Biodiversity in Forests of the Carpathian Mountains* (Amsterdam, IOS Press, 2002).

[18] See http://www.aseansec.org/10202.htm.

[19] See http://www.sei.se/rapidc/pdfs/Male.pdf.

[20] See W. K. Hicks, J. C. I. Kuylenstierna, V. Mathur, S. Mazzucchelli, V. Burijson, S. Shrestha, M. Iyngararasan, S. Simukanga and A. M. Van Tienhoven, "Development of the regional policy process for air pollution in South Asia, southern Africa and Latin America", *Water Air and Soil Pollution*, vol. 30, Nos. 1-4.

[21] See http://www1.york.ac.uk/inst/sei/rapidc2/apina/apina.html.

[22] See http://www.un.org/esa/agenda21/natlinfo/agenda21/issue/ natur.htm#forest.

[23] See J. L. Innes and H. A. Hassan, *Air Pollution and the Forests of Developing and Rapidly Industrializing Countries*, the International Union of Forest-Related Organizations (IUFRO) Series, No. 4 (2000).

[24] See http://www.icp-forests.org.

[25] See http://www.epa.gov/castnet/.

[26] See http://nadp.sws.uiuc.edu/.

[27] See http://www.adorc.gr.jp.

[28] See http://www.impacts.net.cn.

[29] See Holdsworth and Uhl, "Fire in Amazonian selectively logged rain forest and the potential for fire reduction", *Ecological Applications*, vol. 7, No. 2.

[30] Subregional training course on forest health monitoring techniques to assess the sustainability of the region's tropical forest (2002). See www.biotrop.org.

[31] See Global Fire Monitoring Center, "Summary of the global vegetation fire inventory" (November 2002) http://www.fire.uni-freiburg.de/inventory/gvfi.htm.

[32] See FAO, *Global Forest Resources Assessment 2000* (http://www.fao.org.forestry/fo/fra).

[33] See S. E. Page, F. Siegert, J. O. Rieley, H. D. Boehm, A. Jaya and S. Limin, "The amount of carbon released from peat and forest fires in Indonesia during 1997, *Nature*, vol. 420.

[34] Namibia-Finland Forestry Programme, progress reports, 1996-2002.

[35] See http://www.fire.uni-freiburg.de.

[36] See http://www.fs.fed.us/fcamms/.

[37] See V. A. Ipatyev, *Forest, Human, Chernobyl: forest ecosystems after the accident at the Chernobyl Nuclear Power Plant: condition, prediction, response of the population, ways of rehabilitation* (Gomel, 1999) (http://www.ac.by.publications/books.les.html#art).

[38] See J. G. Goldammer, "Early warning systems for the prediction of an appropriate response to wildfires and environmental hazard", in Kee-Tai Goh, D. Schwela, J. G. Goldammer and O. Simpson, eds., *Health Guidelines for Vegetation Fire Events* (Nairobi/Geneva/Singapore, UNEP/WHO/WMO/IEE).

[39] See http://www.fire.uni.freiburg.de/media/news_20020719_ru.htm.

[40] See http://www.efi.fi/projects/dfde/.

[41] See http://www.icp-forests.org/RepTecI.htm.

[42] See http://www.unece.org/trade/timber/storm/storm.htm.

[43] See http://lwf.ncdc.noaa.gov/oa/reports/mitch/mitch.html.

[44] See http://www.nhc.noaa.gov/1998mitch.html.

[45] See V. H. Dale et al., "Forest disturbances and climate change", *BioScience*, vol. 51, No. 9.

[46] See T. L. Root et al., 2003, "Fingerprints of global warming on wild animals and plants", *Nature*, vol. 421.